Appendix B

Creek Sediment Evaluation Documentation

Attachment B-1

Creek Sediment Data Evaluation Document

EVALUATION OF SEDIMENTS IN WILDCAT AND KOKOMO CREEKS

CONTINENTAL STEEL SUPERFUND SITE
Kokomo, Indiana

Remedial Design

WA No. 122-RDRD-05BW / Contract No. 68-W6-0025

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Evaluation of Sediments in Wildcat and Kokomo Creeks

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Introduction

This memorandum summarizes the evaluation of the data collected for the sediments in Wildcat and Kokomo Creeks. The remedial design/remedial action (RD/RA) implementation strategy identified two potential data gaps associated with OU-3 related to the background concentration and the sediment volume estimate (CH2M HILL 2000). The remedial action specified in the Record of Decision (ROD) as it relates to the creeks includes excavation of contaminated sediments and consolidation in the onsite CAMU. The volume of sediments to be removed and consolidated in the ROD (USEPA 1998) was estimated to be 61,000 cubic yards. The ROD estimate was based on the remedial goals in Table 1.

TABLE 1
Remediation Goals for Sediment in Wildcat and Kokomo Creeks: Reaches 1 to 6
Continental Steel Superfund Site

Chemical	Background[a] (μg/kg)	Final Remediation Goal[a] (μg/kg)
Arsenic	14,000	19,000
Beryllium	840	840
Benzo(a)anthracene	1,853	1,853
Benzo(a)pyrene	1,585	1,585
Benzo(b&k)fluoranthene	1,361	1,361
Indeno(1,2,3-cd)pyrene	930	930
Aroclor-1016	—	1,000[b]
Aroclor-1242	4,867	1,000[b]
Aroclor-1248	4,867	1,000[b]
Aroclor-1254	4,867	1,000[b]
Aroclor-1260	—	1,000[b]

[a] From Table 4-6 in the *Final Feasibility Study* (Camp Dresser & McKee, February 28, 1997a).
[b] For the Proposed Plan and ROD, the goals for the PCBs were revised to 5,000 μg/kg based on estimated background concentrations.
— Not reported

Additional Data Collection Activities

Additional data related to the sediment removal action were collected during the geological investigation (Contract 2) in June and July 2001. The investigation was conducted to:

- Determine sediment types and relative amounts
- Determine concentrations of polynuclear aromatic hydrocarbons (PAHs), polychorinated biphenyls (PCBs), arsenic, and beryllium in background sediments
- Verify estimated volume of contaminated sediment

A summary of the data collection activities and findings related to the sediment and creek bank soils are presented Attachment 1 and discussed below.

Delineation of Sediment Thickness

The ROD reported the volume of sediment to be removed and consolidated to be about 61,000 cubic yards. While the ROD identifies stream reaches requiring sediment removal, the depth of sediment contamination was not well defined. The historical data indicated a variable sediment thickness, with parts of the creek bottoms being bedrock, and others consisting of deep pockets of sediment. During the geological investigation, 68 additional physical delineation cross sections were completed along Wildcat and Kokomo Creeks to determine sediment types and relative amount of sediment present. The results of the creek sediment characterization are presented in Table 3 in Attachment 1.

The sediment depths measured during the investigation generally were consistent with that observed during the remedial investigation (RI) conducted by ABB Environmental Services Inc. (ABB) in 1993. The creek bottom of Kokomo Creek varied from 2 inches of sand/silt on a rocky bottom to about 4.8 feet of silt with cobbles near the Highland Park Bridge. As reported in the RI, the major sediment deposits were found primarily near the creek banks and only limited amounts of sediment have been deposited in mid-channel.

The thickness of sediment deposits varied in Wildcat Creek. As shown in Figure 2, little or no sediment typically was measured in the deepest part of the creek channel. In those areas, the streambed consisted of bedrock, cobbles, gravel, and pockets of silty sand. Sediments were deposited primarily along the creek banks, particularly the inside bend of the stream, at the confluence of tributary creeks or drains, and at locations where the stream velocity slowed due to structures (e.g., dams, bridge piers, and islands). The reach of Wildcat Creek between Markland Avenue Bridge and the confluence with Kokomo Creek contained the thickest deposit of sediments ranging from about 0.4 foot (5 inches) to 3 feet of silt to silty sand.

The data from each cross section were input into the GIS database such that the sediment thickness could be used to estimate the volumes for the removal actions.

Reevaluation of Background Concentrations

Remedial cleanup goals for the creek sediments are represented in Table 1 by background concentrations for PAHs, arsenic, and beryllium. The remedial goal for individual aroclors of 1,000 μg/kg is below the background concentration of 4,867 μg/kg. Because the contaminants are present in the background sediments, the adequacy of the background sample populations was reassessed such that the sediment removal is limited to that related to the site.

Six additional background locations were sampled (three upstream for Kokomo Creek and three upstream for Wildcat Creek) during the geological investigation (see Figure 2 in Attachment 1). The analytical results for the six locations were included with the data used in the background evaluation performed in the baseline risk assessment (Appendix B; CDM 1997b). The evaluation of the historical and new data indicated that the types and levels of chemicals detected in the background samples appeared to be different for Kokomo and Wildcat Creeks. Thus, separate background concentrations were calculated for each creek. The results of the reevaluation of the background concentrations are summarized in Table 2. The background evaluation is included as Attachment 2.

TABLE 2
Background Concentrations for Sediment in Wildcat and Kokomo Creeks
Continental Steel Superfund Site

Chemical	Background * (µg/kg)	Reevaluated Background (µg/kg)	
		Kokomo Creek	Wildcat Creek
Arsenic	14,000	7,000	32,300
Beryllium	840	720	580
Benzo(a)anthracene	1,853	7,100	915
Benzo(a)pyrene	1,585	4,849	881
Benzo(b&k)fluoranthene	1,361	12,046	1,710
Indeno(1,2,3-cd)pyrene	930	3,480	875
Aroclor-1016	—	240	420
Aroclor-1242	4,867	120	210
Aroclor-1248	4,867	937	210
Aroclor-1254	4,867	120	370
Aroclor-1260	—	250	210

* From Table 4-6 in the Final Feasibility Study (Camp Dresser & McKee, February 28, 1997a)
— Not reported

The reevaluated background concentrations for PCBs generally are one order of magnitude lower than that calculated during the RI/FS (i.e., 4,867 µg/kg). The reevaluated PCB background concentrations are consistent with the results from additional studies conducted by IDEM in January 2000 that indicated the background PCB levels in both Kokomo and Wildcat Creeks are nondetect (Letter to USEPA from IDEM, February 2001). Therefore, this evaluation assumes the remediation goal for the individual aroclors to be 1,000 µg/kg.

The concentrations of PAH in background sediment in Kokomo Creek are considerably higher than in Wildcat Creek. The background concentrations for the individual PAHs estimated in the RI/FS generally fall between the reevaluated background concentrations calculated individually for the creeks. Thus, for comparison purposes this evaluation uses the values for the individual PAH compounds specified in the FS as the remediation goal (Table 1). Although this may increase the sediment volume to be removed from Kokomo Creek, removal will prevent discharge of sediments with higher PAH concentrations into Wildcat Creek.

Surface Weighted Average Approach

The ROD specifies that the sediment in Wildcat and Kokomo Creeks exceeding the remedial goals would be subject to potential remediation. In developing cleanup approaches for rivers, USEPA has been using a method called Surface Weighted Average Concentration (SWAC), which determines the average concentration of a contaminant for a particular length of river. For the sediments in Wildcat and Kokomo Creeks, the SWAC approach was used to examine the overall effectiveness and the impacts to the estimated volume of contaminated sediment should different remediation goals be considered.

The basis of the SWAC approach is that the exposure domain for receptors is broader than the small areas represented by individual samples, and so an average concentration of the exposure domain should be used. In the human health risk assessment, the risk to recreational visitors was based on the exposure domains consisting of the individual reaches. However, the ecological risk assessment was based on the exposure domain including both Wildcat and Kokomo Creeks (CDM 1997b). Thus, the application of the SWAC methodology to the sediment in Wildcat and Kokomo Creeks should include both the individual reaches as well as the entire creek system. The following steps were used to develop the SWACs for the individual reaches and for roughly 2 miles of creek.

1. The creeks were divided into seven reaches, and the boundaries for each reach were delineated within the GIS database (see Figure 1). An additional reach representing Shambaugh Run was added to the six originally presented in the ROD. Kitty Run Drain was not included in this SWAC evaluation. During a site visit on March 6, 2002, it was observed that as part of the recent Dixon Road bridge work, the segment of Kitty Run Drain along Dixon Road was replaced with two 60-inch-diameter concrete storm sewers. Therefore, the sediments in Kitty Run Drain need not be considered for removal.

   It should be noted that for this evaluation, a historical sample location (SD-103) was moved on the maps such that it would lie along the stream bank rather than in the wetland areas adjacent to the creeks. Based on the information in the RI report, it could not be determined if the location coordinates were incorrect or if the sample was actually of the wetland sediments. Moving the sample location slightly allowed use of all available sediment results in the development of the SWAC for the reach.

   The previous sediment evaluation was based on data from sediment samples collected near the center of the stream (as permitted based on sediment availability). However, the ROD indicates that the sediment to be excavated also occurs along the edges of the streams or at bends in the channels. During the geological investigation, additional sampling was conducted near or at the edge of the creeks, within the normal seasonal zone of water level fluctuations. Thus, the width of the reaches was expanded to include a 5-foot strip outside of the creek bed, as defined on the base map, to allow inclusion of these "creek bank" samples.

2. Each sediment location was assigned a reach identifier such that a SWAC could be calculated for each of the seven reaches.

3. The estimated area of river bottom to be assigned to each sample core was determined based on polygonal declustering. This method divides the total area of influence into polygons, one for each sample, with the area of the polygon representing the relative

weighting of that sample. The polygons of influence, or Theissen polygons, are drawn using the GIS tool, such that a polygon contains all the area that is closer to a given sample point than to any other sample point. The area polygons used in this evaluation are shown in Figure 1.

4. Upon defining the Theissen polygons for each sediment sample location, the weighted concentration for each polygon (Cw_i) was calculated by multiplying the concentration (C_i) by the area (A_i), or:

$$Cw_i = C_i \times A_i$$

5. The products of the sediment concentrations and surface areas were summed and the total divided by the total surface area for each reach to get a SWAC for the entire reach, or:

$$SWAC_{\mathrm{Re}\,ach} = \frac{\sum_{i=1}^{n} Cw_i}{A_{reach}}$$

6. Once the SWACs were determined for the individual reaches, a representative sediment deposit SWAC was calculated to represent sediment in seven reaches (i.e., both creeks):

$$SWAC_{Creek} = \frac{\sum_{r=1}^{7} SWAC_{\mathrm{Re}\,ach,r} \times Area_{reach,r}}{A_{creek}}$$

The methodology requires that each polygon area be assigned a representative sediment concentration. However, the database included multiple results from a single location, either from samples being analyzed first by a field laboratory then submitted in a later phase to an offsite laboratory or from samples collected from different depths. Thus, prior to calculating the SWAC for the different reaches, a representative concentration for each sample location was determined.

- If results for a location included field and offsite laboratory analyses, the offsite laboratory data were used. The offsite laboratory results were for samples collected during ABB's additional creek sediment sampling activities and analyzed using detection limits lower than the field analyses.

- If two samples were collected at a location at different depths, an average of the results was used. This process allows the data to be comparable to results from other investigations that included collection and analyses of depth-composite samples (this approach is consistent with the calculation of background).

- If the result was not detected, one-half the detection limit was used (this approach is consistent with the calculation of background).

The calculated SWACs for each reach and for the overall creek, based on the existing analytical data, are summarized in Table 3. In addition, tables used to calculate the SWACs are included as Attachment 3.

TABLE 3
Summary of Estimated SWACs Under Different Potential Removal Actions
Continental Steel

Stream Segment	Area Of Influence (ft2)	Parameter	Remedial Goal (µg/kg)	Surface Weighted Average Concentration (SWAC) in µg/kg: Existing Condition	Replace C > 10 x RG with PQL	Replace C > 5 x RG with PQL	Replace C > RG with PQL	Replace Aroclor > 3 x RG and PAH > 5 x RG with PQL*
1	163,272	Aroclor-1248	1,000	**9,888**	**1,623**	**1,279**	256	862
		Benzo(a)anthracene	1,853	430	430	297	240	277
		Benzo(a)pyrene	1,585	434	434	427	434	425
		Benzo(b&k)fluoranthene	1,361	344	326	259	242	249
		Indeno(1,2,3-cd)pyrene	930	259	259	229	218	229
2	167,587	Aroclor-1248	1,000	**16,350**	**1,630**	**1,339**	117	310
		Benzo(a)anthracene	1,853	1,322	407	407	264	384
		Benzo(a)pyrene	1,585	1,031	299	299	304	258
		Benzo(b&k)fluoranthene	1,361	**2,198**	319	319	293	306
		Indeno(1,2,3-cd)pyrene	930	766	276	276	260	260
3	267,209	Aroclor-1248	1,000	**4,215**	**2,125**	**1,111**	155	348
		Benzo(a)anthracene	1,853	453	361	340	259	292
		Benzo(a)pyrene	1,585	394	302	245	275	213
		Benzo(b&k)fluoranthene	1,361	700	484	415	308	321
		Indeno(1,2,3-cd)pyrene	930	297	262	252	229	240
4 (Kokomo Creek)	159,820	Aroclor-1248	1,000	**26,984**	683	425	154	356
		Benzo(a)anthracene	1,853	**1,892**	1,090	596	328	596
		Benzo(a)pyrene	1,585	828	687	495	352	495
		Benzo(b&k)fluoranthene	1,361	**2,441**	**1,506**	631	387	631
		Indeno(1,2,3-cd)pyrene	930	570	496	354	266	354
5	240,612	Aroclor-1248	1,000	**6,255**	369	369	154	256
		Benzo(a)anthracene	1,853	684	639	598	347	599
		Benzo(a)pyrene	1,585	569	545	545	279	545
		Benzo(b&k)fluoranthene	1,361	1,008	941	963	389	941
		Indeno(1,2,3-cd)pyrene	930	540	522	522	272	522
6	290,233	Aroclor-1248	1,000	290	290	285	124	188
		Benzo(a)anthracene	1,853	967	967	614	294	545
		Benzo(a)pyrene	1,585	1,030	1,030	685	307	616
		Benzo(b&k)fluoranthene	1,361	**1,793**	**1,793**	990	360	818
		Indeno(1,2,3-cd)pyrene	930	899	899	482	311	470
8 (Shambaugh (Run)	10,703	Aroclor-1248	1,000	35	35	35	35	35
		Benzo(a)anthracene	1,853	461	461	461	461	461
		Benzo(a)pyrene	1,585	484	484	484	484	484
		Benzo(b&k)fluoranthene	1,361	1,235	1,235	1,235	1,235	1,235
		Indeno(1,2,3-cd)pyrene	930	173	173	173	173	173
Total Creek	1,299,438	Aroclor-1248	1,000	**8,749**	**1,069**	746	153	353
		Benzo(a)anthracene	1,853	897	653	485	292	461
		Benzo(a)pyrene	1,585	710	575	461	315	434
		Benzo(b&k)fluoranthene	1,361	**1,368**	956	642	342	581
		Indeno(1,2,3-cd)pyrene	930	565	482	366	173	358
		Volume of Sediment (yd^3)			2,943	6,415	21,462	9,489

RG = Remediation Goal per Table 4-6 in Final FS (CDM 1997)
Numbers in **bold** exceed the Final Remediation Goal

* Includes removal of four additional polygons in Section 2 (SD-068, SD-040, SD-072 and SD073) with PCB concentrations > RG

The SWAC approach was used for evaluating one PCB (Aroclor 1248) and the individual PAHs. The SWACs for the other aroclors were not calculated, as the data were not as extensive and Aroclor 1248 was considered representative of the other PCBs. It should be noted that the remediation goals are for the individual aroclors rather than a total PCB concentration. However, the area polygons containing aroclor concentrations exceeding the criteria were included in the evaluation of the different removal scenarios. The SWACs for beryllium and arsenic were also not calculated. Beryllium was detected in about 20 percent of the samples (62 of 313 samples). The reported detection limits for beryllium ranged from about 0.5 to 4 mg/kg, most often exceeding the remediation goal (0.84 mg/kg) and the calculated background concentrations (0.72 mg/kg for Kokomo Creek, 0.58 mg/kg for Wildcat Creek). The detection limit rather than the detected concentrations controlled the calculated SWACs for the reaches and the entire creek. Thus, the results provided little useful information on the overall creek conditions. Arsenic also was not evaluated using the SWAC approach because concentrations were reported for only about half of the sample locations. Although the SWACs were not calculated for the individual aroclors except for Aroclor 1248, beryllium or arsenic, the effectiveness of different sediment removal actions in reducing the overall concentration of these contaminants were evaluated by examining the percent mass reduction resulting from each action.

Existing Conditions

Table 3 presents the SWACs for the individual reaches and the entire creek for Aroclor 1248 and the PAHs under existing conditions. The SWACs for Aroclor 1248 for four of the seven reaches exceed the remediation goal specified in the FS by almost one order of magnitude. The SWAC representing the Aroclor 1248 concentration of the entire creek (8,750 μg/kg) also exceeds the remedial goal by almost an order of magnitude. Kokomo Creek appears to be the most contaminated section of the entire creek area.

In general, the SWAC for the PAHs do not appear to be significantly greater than the remediation goals, as specified in the FS. As expected, based on the background concentrations, the PAH concentrations were the highest in Kokomo Creek (Reach 4). The SWACs for benzo(a)anthracene and benzo(b,k)fluroanthene both exceeded their respective remediation goals. The highest SWACs were calculated for benzo(b,k)fluroanthene, which may be attributed to the concentrations being the sum of benzo(b)fluroanthene and benzo(k)fluroanthene rather than a concentration for an individual compound. The SWAC for benzo(b,k)fluroanthene exceeded its remediation goal for three of the seven reaches. In addition, the SWAC representing the benzo(b,k)fluroanthene concentration for the entire creek just slightly exceeded its criteria (1368 compared with 1361 μg/kg). With the exception of Kokomo Creek, none of the SWACs for the other PAHs exceeded their respective remediation goals.

Post-remediation (Removal)

The SWAC approach was used to evaluate the overall effectiveness of potential removal actions on the creek environment. A theoretical post-remediation SWAC for the creek was calculated for different removal action activities. The removal action was modeled by replacing the existing concentrations with the remedial goal, background concentration, or the practical quantitation limit (PQL). The effectiveness of the action could then be assessed by comparing the pre- and post-remedial conditions, based on the changes in the calculated SWAC or estimated percent mass reduction for the entire creek.

The various removal actions were modeled in two steps. The first step was to identify the range of cleanup that would be necessary to meet the remedial goals. This was accomplished by evaluating the effectiveness of the different removal actions for each individual compound (i.e., Aroclor 1248 and the individual PAHs). The SWACs determined from this initial evaluation are included in Attachment 3.

The removal of sediments containing Aroclor 1248 concentrations greater than 10,000 μg/kg (i.e., 10 times the remedial goal) results in a SWAC for the entire creek of about 1,100 μg/kg, about a 90-percent reduction in the overall concentration in the creek. The goal of 1,000 μg/kg could be achieved for the entire creek by removing sediments with aroclor concentrations greater than 5,000 μg/kg. This removal action results in an overall creek SWAC ranging from 870 to about 780 μg/kg, depending on the replacement value used. In order for SWAC for the entire creek to be below the reevaluated background concentration (210 μg/kg for Wildcat Creek), all sediment with concentrations greater than 1,000 μg/kg would have to be removed until Aroclor 1248 is no longer detected (i.e., less than the PQL of 33 μg/kg).

Based on the SWACs for the entire creek, with the exception of benzo(b,k)fluroanthene, which barely exceeds its goal, the individual PAHs do not exceed their respective remediation goals or reevaluated background concentrations. However, with a few exceptions, the removal of sediment with concentrations greater than 5 times the remedial goal will lower the SWAC for the individual reaches to near the reevaluated background concentrations.

Based on the evaluation of individual compounds, different removal actions were modeled to include the removal of sediment containing levels of either PCB or PAH concentrations exceeding the goals. The different removal actions evaluated were:

- Remove sediment with PCB or PAH concentrations exceeding 10 times the remedial goal
- Remove sediment with PCB or PAH concentrations exceeding 5 times the remedial goal
- Remove sediment with PCB or PAH concentrations exceeding the remedial goal

The locations/polygons with concentrations of Aroclor 1248 or PAHs exceeding the different criteria were identified such that the model would represent removing sediment containing PCBs or PAHs that exceeded the selected criteria. The theoretical SWACs under the various removal scenarios and calculated for different quality replacement materials are included in Attachment 3. A summary of the different removal scenarios modeled by replacing the concentrations exceeding the criteria with the PQL is presented in Table 3; the areas to be removed are shown in Figures 3, 4, and 5. The percent reduction in mass for the different removal scenarios is summarized in Table 4.

The removal of sediment with concentrations exceeding 10 times the remediation goals would remove about 93 percent of the mass of Aroclor 1248 and between 15 and 35 percent of the mass of the individual PAHs. However, this removal scenario would not be sufficient to reduce the SWAC for the entire creek (1,069 μg/kg) to be below the 1,000-μg/kg goal for Aroclor 1248.

TABLE 4

Summary of Percent Change in Mass Under Different Potential Removal Actions

Continental Steel

Parameter	Percent Change in Mass			
	Replace C > 10 x RG	Replace C > 5 x RG	Replace C > 3 x RG[a]	Replace C > RG
PCBs				
Aroclor 1248	-92	-94	-97	-99
Aroclor 1016[b]	-95	-95	-98	-98
Aroclor 1242[b]	-58	-94	-95	-96
Aroclor 1254[b]	-87	-89	-94	-98
Aroclor 1260[b]	-80	-80	-80	-95
Total PCBs[c]	-91	-94	-97	-98
PAHs				
Benzo(a)anthracene	-35	-50	-53	-71
Benzo(a)pyrene	-17	-33	-38	-56
Benzo(b&k)fluoranthene	-34	-54	-60	-76
Indeno(1,2,3-cd)pyrene	-14	-34	-36	-53
Metals				
Arsenic	-17	-35	-40	-62
Beryllium	-2.1	-3.7	-8.1	-16.8

[a] Includes removal and replacement of PCB concentrations > 3 x RG and PAH concentrations > 5 x RG. Also includes removal of four additional polygons in Section 2 (SD-068, SD-040, SD-072 and SD073) with concentrations > RG.

[b] Percent change based on only those polygons with analytical results.

[c] Based on sum of individual PCB concentrations reported. Not all locations had concentrations reported for all aroclors.

Based on the estimated SWAC for the entire creek, the remediation goals could be achieved by removing the PCB- and PAH-contaminated sediment with concentrations exceeding 5 times their respective goals. This action would reduce the overall PCB mass by about 94 percent and would consist of the removal and consolidation of about 6,400 cubic yards of sediment. Under this scenario, the western (downstream) reaches of Wildcat Creek (Sections 1, 2 and 3) would have SWACs slightly exceeding the 1,000-μg/kg goal for Aroclor 1248 (SAC for the reaches of 1,100 to 1,300 μg/kg). Although the 1,000-μg/kg goal could be attained by removing sediments with aroclor concentrations less than 5,000 μg/kg (i.e., 5 times the goal) from the three western sections, it would not be appropriate for downstream sections (e.g., Sections 1, 2, or 3) to be remediated to levels lower than the upstream reaches. Thus, to get the SWACs for the individual reaches below the 1,000 μg/kg for Aroclor 1248, all sediments with concentration exceeding the remediation goal would need to be removed. Although this would result in an additional 20 percent reduction in the SWAC for the overall creek (decrease from 746 to 153 μg/kg), the amount of sediment that would need to be removed would increase dramatically (from about 6,400 to 21,500 cubic yards). In addition, the overall mass reduction would not change significantly (from about 94 to 99 percent mass of total PCBs).

Based on discussions with IDEM, one other scenario was evaluated to reduce the PCB concentrations in the overall creek sediments. The alternative consisted of removing sediments with PCB concentrations exceeding 3 times the remedial goal (i.e., 3,000 μg/kg) and PAH concentrations greater than 5 times their respective remedial goals. Under this scenario, about 8,460 cubic yards of sediment would be removed. Although this scenario would result in the SWAC representing PCB concentrations in the entire creek to be about 480 μg/kg, the SWAC for Section 2 (1,168 μg/kg) would still exceed the remediation goal. It was determined that by removing four additional polygon areas of Section 2 (an additional 1,030 cubic yards of sediment), the SWAC for Section 2 would decrease to about 350 μg/kg, meeting the overall goal of individual sections to be below 1,000 μg/kg (see Figure 6).

Although the SWAC methods were only applied to Aroclor 1248, the percent reduction in mass for the remaining aroclors resulting from the removal actions were examined to assess the overall effectiveness of action. The majority of the areas containing elevated levels of Aroclor 1016, 1242, 1254, and 1260 also contained elevated levels of Aroclor 1248 or PAHs. The implementation of the removal scenario recommended by IDEM would result in a mass reduction of between about 80 and 98 percent of the individual aroclors and an approximately 97-percent reduction of total PCBs from the creeks.

The SWAC methods were also not applied to beryllium and arsenic, but the effectiveness of the removal actions to lower the concentrations of these metals in the creek sediments was examined. Fourteen of the 32 locations with detected beryllium concentrations exceeded the background level of 580 μg/kg for Wildcat Creek, and only three exceeded 0.84 μg/kg. The detected concentrations ranged from about 600 μg/kg to a maximum concentration of 3,900 μg/kg. Most of the exceedances were found in upstream sections of Wildcat Creek (Sections 5 and 6). The location with the highest concentration (39,000 μg/kg) was detected in Section 1 from a location also containing elevated PCB concentrations that has been identified for removal. As indicated by the low percent of mass reduction (about 8 percent), the areas with elevated beryllium concentrations do not generally contain high concentrations of PCBs (i.e., greater then 3,000 μg/kg) or PAHs (i.e., greater than 5 times the remediation goal) and have not been identified for removal (see Table 4). However, the remaining locations contain concentrations of less than 2 times the background levels and will not contribute a significant mass of beryllium to downstream areas. None of the sediment samples collected from Kokomo Creek exceeded the background concentration level of 720 μg/kg.

Arsenic was detected in 62 of the 74 sediment samples analyzed for arsenic. In Wildcat Creek, the detected arsenic concentrations slightly exceeded the background concentrations in nine of 52 locations found mainly along the Slag Pile Area and the Main Plant (Sections 2 and 5, respectively). The arsenic concentrations ranged from 36,350 to 121,000 μg/kg, with most just exceeding the background concentration of 32,300 μg/kg. The highest concentration of arsenic found in Stream Section 1 (SD-218) and the arsenic-contaminated sediments in Sections 2 and 6 will be removed with PCB- or PAH-contaminated sediments. The three of areas in Section 5 with arsenic concentrations (37,000 to 63,400 μg/kg) less than twice the background concentration will not be remediated with the removal of PCB- and PAH-contaminated sediments. One of the 10 locations sampled in Kokomo Creek exceeded the background concentration of 7,000 μg/kg. The arsenic concentration (14,450 μg/kg) is about 2 times higher than the background concentration for Kokomo Creek. That location (SB-33A) also contains elevated concentrations of PCBs that will be removed. Removing sediments with PCB concentrations greater than 3 times the remedial goal (with additional areas in Section 2) and PAH concentrations greater than 5 times the remedial goal would reduce the overall mass of arsenic in the creek sediments by about 40 percent (see Table 4).

Remediation Costs

Capital costs for implementing the remedial action were estimated using costs from the FS, refined volume estimates, and hard dollar quotes form vendors (in particular for the creek diversion costs). These costs are presented in Table 5, with associated cost estimate tables presented in Attachment 5.

TABLE 5
Summary of Estimated Costs Under Different Potential Removal Actions
Continental Steel Superfund Site

	Replace C > 10 × RG with PQL	Replace C > 5 × RG with PQL	Replace Aroclor > 3 × RG and PAH > 5 × RG with PQL*	Replace C > 1 × RG with PQL
Volume Removed	2,900 yds^3	6,400 yds^3	9,500 yds^3	21,500 yds^3
Construction Cost	$ 4,245,110	$ 7,532,990	$ 7,672,045	$ 13,136,715
Bid Contingency (15%)	$ 636,767	$ 1,129,949	$ 1,150,807	$ 1,970,507
Scope Contingency (20%)	$ 849,022	$ 1,506,598	$ 1,534,409	$ 2,627,343
Total Capitol Cost	$ 5,730,899	$ 10,169,537	$ 10,357,261	$ 17,734,565

*Includes removal of four additional polygons in Section 2 (SD-068, SD-040, SD-072 and SD073) with PCB concentrations > RG.

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